TO COMPARE ANATOMICAL PARAMETERS AND BIOMETRIC FINDINGS OF OCULAR STRUCTURES IN PHACOMORPHIC GLAUCOMA, INTUMESCENT CATARACT WITH NORMAL EYES USING ULTRASOUND BIOMICROSCOPE AND CONVENTIONAL A SCAN

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This is to certify that the dissertation entitled "**TO COMPARE ANATOMICAL PARAMETERS AND BIOMETRIC FINDINGS OF OCULAR STRUCTURES IN PHACOMORPHIC GLAUCOMA, INTUMESCENT CATARACT WITH NORMAL EYES USING ULTRASOUND BIOMICROSCOPE AND CONVENTIONAL A SCAN**" is a Bonafide work done by **DR.RAMEEZ N HUSSAIN**, Postgraduate student in M.S. (Ophthalmology) during MARCH 2007 to MARCH 2010, under our direct supervision and guidance, at our Institute, in partial fulfillment for the award of M.S. Degree in Ophthalmology for the Tamilnadu Dr.M.G.R. Medical University, Chennai.

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PROFORMA

MASTER CHARTS

Introduction

INTRODUCTION

Lens induced glaucomas are a common occurrence in India, hardly surprising in a situation where the incident of cataract cases far exceeds the total number of surgeries performed currently. Though these are clinically distinct entities, they have certain common factors in that they are lens induced, they compromise the function of the optic nerve due to rise of intraocular pressure, cataract surgery is curative in these cases, and finally they uniformly share a guarded prognosis.

With a cataract backlog of around 12 million and annually increasing at an estimated rate of 3.8 million, it is not surprising that the occurrence of lens induced glaucomas is not an infrequent event in India. Though not all inclusive, these lens induced glaucomas (LIG) are either secondary angle closure glaucomas (phacomorphic glaucomas) or secondary open angle glaucomas

Among lens induced glaucomas, phacomorphic glaucoma has a higher incidence (52.7%) when compared to Phacolytic glaucoma (47.3%). Phacomorphic glaucoma is the term used for secondary angle-closure glaucoma due to lens intumescence. The increase in lens thickness from an advanced cataract, a rapidly intumescent lens, or a traumatic cataract can lead to pupillary block and angle closure or it may be due to forward displacement of the lens-iris diaphragm.

Phacomorphic glaucomas were recognized by the subjective complaints of pain and redness associated with the presence of corneal edema, shallow anterior

chamber, an intumescent cataractous lens and intraocular pressure above 21 mmHg.

Phacomorphic glaucoma is more common in smaller hyperopic eyes with a larger lens and a shallower AC. Recognizing phacomorphic glaucoma is important. After medical therapy to control glaucoma, the pupillary block needs to be relieved. Patients require cataract extraction for phacomorphic glaucoma at the earliest.

Many biometric studies are available on primary angle closure glaucoma eyes but no biometric studies are available on phacomorphic glaucoma. Biometric studies of phacomorphic glaucoma may provide insight into the pathophysiology and show which eyes are more prone to develop glaucoma in order to initiate early treatment avoiding poor post operative visual acuity outcomes

Aim of the study

AIM OF THE STUDY

To analyze anatomical parameters and biometric findings of ocular structures in phacomorphic glaucoma, intumescent cataract and compare them with normal eyes using Ultrasound Biomicroscope and conventional A Scan

Review of literature

REVIEW OF LITERATURE

LENS-INDUCED GLAUCOMAS

The crystalline lens is implicated as a causative element in producing several forms of glaucoma. Etiologically they represent diversity in the presentation of the glaucomatous process. These conditions include glaucoma related to: lens dislocation (ectopia lentis), lens swelling (intumescent cataract), classical pupillary block, aqueous misdirection--ciliary block, phacoanaphylaxis, lens particle and phacolytic glaucoma. The management of elevated intraocular pressure often requires altering the intraocular relationship of anatomic structures surrounding the lens or lens removal.[1,2]

Lens induced glaucomas are a common occurrence in India, hardly surprising in a situation where the incident of cataract cases far exceeds the total number of surgeries performed currently. Though these are clinically distinct entities, they have certain common factors in that they are lens induced, they compromise the function of the optic nerve due to rise of intraocular pressure, cataract surgery is curative in these cases and finally they uniformly share a guarded prognosis[2].

Entity	***Angle status***	***Mechanism***
Phacolytic glaucoma	Open	Outflow obstruction by lens protein and macrophages
Lens-particle glaucoma	Open	Outflow obstruction by lens particles, possibly inflammatory cells
Glaucoma-associated with retained intravitreal lens	Open	Outflow obstruction by lens particles, lens protein, fragments, inflammatory cells (vitreous component?)
Glaucoma associated with phacoanaphylactic uveitis	Open or closed	Outflow obstruction due to inflammation; pupillary block
Phacomorphic glaucoma	Closed	Pupillary block; rarely direct compression of angle by intumescent lens
Glaucoma due to ectopia lentis	Closed	Pupillary block

PHACOLYTIC GLAUCOMA

Phacolytic glaucoma (PG) is the sudden onset of open-angle glaucoma caused by a leaking mature or hypermature (rarely immature) cataract. It is cured by cataract extraction.[3,5,6]

PATHOPHYSIOLOGY

In contrast to some forms of lens-induced glaucomas (eg, lens particle glaucoma, phacoanaphylactic glaucoma), phacolytic glaucoma occurs in cataractous lenses with intact lens capsules. The available evidence implicates direct obstruction of outflow pathways by lens protein released from microscopic defects in the lens capsule that is intact clinically.

The high molecular weight proteins found in cataractous lenses produce outflow obstruction in experimental perfusion studies similar to that found in phacolytic glaucoma[5]. Although a macrophagic response is typically present, macrophages are believed to be a natural response to lens protein in the anterior chamber rather than the cause of the outflow obstruction.

Phacolytic glaucoma occurs more frequently in underdeveloped countries. Most cases resolve after cataract extraction with excellent improvement in vision. No racial or sexual predilection exists. Phacolytic glaucoma typically occurs in older adults. The youngest patient reported was age 35 years. Patients with phacolytic glaucoma typically have a history of slow vision loss for months or years prior to the acute onset of pain, redness, and sometimes further decrease in vision[6]

Vision may only be inaccurate light perception due to the density of the cataract. Symptoms mimic acute angle-closure glaucoma The history of slow vision loss due to advancing cataract preceding the acute onset of symptoms is a vital clue to the correct diagnosis. Intraocular pressure (IOP) characteristically is elevated severely in phacolytic glaucoma[7].

Slit lamp examination of phacolytic glaucoma typically reveals microcystic corneal edema, and the anterior chamber contains intense flare, large cells (macrophages), aggregates of white material, and iridescent or hyperrefringent particles. The latter represent calcium oxalate and cholesterol crystals being liberated from the degenerating cataractous lens.

Unlike uveitic glaucoma (such as that seen in phacoanaphylactic glaucoma), no keratic precipitates typically are present[8]. The anterior capsule of the lens frequently is dotted with patches of soft white material. In contrast to some forms of lens-induced glaucomas (eg, lens particle glaucoma, phacoanaphylactic glaucoma), the lens capsule is grossly intact.

Gonioscopy findings usually are normal; however, evidence of old angle recession was found in 25% of eyes in one study. Causes are Mature cataract (totally opacified), hypermature cataract (liquid cortex and free-floating nucleus), focal liquefaction of immature cataract (rare), dislocated cataractous lens in vitreous[9].

LENS PARTICLE GLAUCOMA

Lens-particle glaucoma, a sub classification of lens-induced glaucoma [11,12,13] is a type of secondary open-angle glaucoma involving intraocular retention of fragmented lens debris. Following surgery or injury, lens material may be sequestered within the capsular bag or dislocated into other areas of either the posterior eye or the anterior eye.

Characteristically, large lens pieces spontaneously fragment further into small (sometimes invisible) particles that eventually migrate into the anterior chamber and obstruct aqueous outflow[14]. Lens-particle glaucoma is not associated with decentration or dislocation of an intact lens.

PATHOPHYSIOLOGY

The mechanism involves the following 4 processes: (1) presence of a nonintact lens capsule, usually violated during trauma or intraocular surgery; (2) dislocation of lens fragments into the anterior or posterior segment, with subsequent release of lens particles into the anterior chamber; (3) obstruction of trabecular meshwork by lens debris[6] and inflammatory components[14]; and (4) reduction of the outflow facility of an open anterior chamber angle, resulting in elevation of intraocular pressure (IOP).

PHACOANAPHYLAXIS

Phacoanaphylaxis/lens-induced uveitis occurs in the setting of a ruptured or degenerative lens capsule and is characterized by a granulomatous antigenic reaction to lens protein[16,17,18]. Before the modern era of microsurgery, this disease was more common, and the diagnosis was often made histologically, as eyes with phacoanaphylaxis were often enucleated for intractable inflammation and secondary glaucoma.[17,18]

With improved microsurgical techniques, especially with the introduction of extra capsular cataract extraction and phacoemulsification, the incidence of phacoanaphylaxis has decreased dramatically and rarely occurs in its originally described form. However, chronic postoperative uveitis following phacoemulsification with retained lens material is still a well-known complication of cataract surgery and is the result of the same pathophysiology as the classically described entity of phacoanaphylaxis[19,20]

PHACOMORPHIC GLAUCOMA

Secondary angle-closure glaucoma due to lens intumescence is called phacomorphic glaucoma. Rapid swelling of the lens can occur in eyes with advanced senile cataracts and in eyes with cataracts caused by trauma and inflammation. Rapid lens swelling may result in pupillary block or forward displacement of the lens-iris diaphragm.

Phacomorphic glaucoma should be differentiated from **primary angle-closure has the following features:**

- Normal lens growth
- Short axial length
- Preexisting differences in the anatomy of the iridocorneal angle
- Zonular relaxation
- Pupillary block can cause acute intraocular pressure elevations.

Phacomorphic glaucoma may be conceptualized as persistent appositional closure despite elimination of the pupillary block. Asymmetric central shallowing of the anterior chamber in the presence of a unilateral mature intumescent cataract and elevated intraocular pressure should alert the examiner to the possibility of phacomorphic glaucoma.[21,22]

This condition has been referred to as phacomorphic glaucoma (Duke-Elder S.,1969). The angle closure may be caused by an enhanced pupillary block mechanism or by forward displacement of the lens-iris diaphragm, in either case, the diagnosis is usually made by observing a mature, Intumescent cataract associated with a central anterior chamber depth that is significantly shallower than that of the fellow eye.

Increasing lens thickness due to growth of the lens cortex is a well-recognized factor in the development of primary angle-closure glaucoma

The diagnosis of phacomorphic glaucoma should be entertained when unilateral or asymmetric cataract is associated with shallowing of the anterior chamber angle not explained by other factors. (e.g., miotic therapy, lens subluxation, or uveal effusion). It is wise to rule out a posterior segment mass in an eye with unilateral phacomorphic glaucoma, using ultrasonography if necessary.[23,24]

The differentiation of phacomorphic glaucoma from primary angle-closure glaucoma is sometimes difficult. Both conditions respond to laser iridotomy (unless extensive peripheral anterior synechiae exist), indicating a common mechanism of pupillary block.[25] The uncommon development of phacomorphic glaucoma despite adequate iridotomy suggests that with extreme degrees of lens enlargement in small eyes, the peripheral iris may be directly pushed against the trabecular meshwork by the lens without pupillary block.

PATHOPHYSIOLOGY

In an eye with advanced cataract formation, the lens is swollen or intumescent. Progressive reduction occurs in the iridocorneal angle. In such eyes, pupillary block glaucoma is caused by changes in the size of the lens and the position of the anterior lens surface. Angle closure may be secondary to an

enhanced pupillary block mechanism, or it may be due to forward displacement of the lens-iris diaphragm.[38]

CLINICAL FEATURES

History

Patients with phacomorphic glaucoma complain of acute pain, blurred vision, rainbow-colored halos around lights, nausea, and vomiting.

Patients generally have decreased vision before the acute episode because of a history of a cataract.

PHYSICAL SIGNS

- High intraocular pressure (IOP) - Greater than 35 mm Hg
- Mid dilated, sluggish, irregular pupil
- Corneal edema
- Injection of conjunctival and episcleral vessels
- Shallow central anterior chamber (AC)
- Lens enlargement and forward displacement
- Unequal cataract formation between the 2 eyes

CAUSES

Certain factors predispose a patient to phacomorphic glaucoma, as follows:

- Short axial length of the eye
- Pre-existing individual differences in the anatomy of the anterior segment
- Zonular relaxation may also contribute variably
- Intumescent cataract
- Traumatic cataract
- Rapidly developing senile cataract
- Smaller hyperopic eyes with a larger lens and a shallower AC.
- Zonular weakness secondary to exfoliation, trauma, or age.

An angle-closure attack can be precipitated by pupillary dilation in dim light. The dilation to mid position relaxes the peripheral iris so that it may bow forward, coming into contact with the trabecular meshwork, setting the stage for pupillary block. Angle closure also is facilitated by the pressure originating posterior to the lens and the enlargement of the lens itself.[37]

Workup includes a comprehensive slit lamp examination, Applanation tonometry, Direct or indirect Fundus examination to rule out optic disc cupping.

Gonioscopy shows a closed AC angle, B Scan in case of mature cataract to know the posterior segment status and also to rule out optic nerve head cupping,

Optical coherence tomography (OCT) is useful in the visualization of the anterior chamber angle.[28,29]

Ultrasound Biomicroscopic imaging for precise analysis of anterior segment morphometry and Axial scan will reveal the lens thickness and the relative forward displacement of the iris lens diaphragm

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TREATMENT

The definitive treatment of phacomorphic glaucoma in eyes with potential for visual improvement is cataract surgery. Because angle-closure glaucoma can be precipitated or worsened by the mydriasis required for lens removal, laser iridotomy should be considered before cataract surgery to avoid the hazards of intraocular surgery in an eye with severe pressure elevation. The creation of a safe and controlled capsulorhexis during the cataract procedure may be facilitated by prior aspiration of liquid cortex from the lens using a 30-gauge needle[38]

Recognizing phacomorphic glaucoma is important. After medical therapy to control glaucoma, the pupillary block needs to be relieved. Most patients require cataract extraction for phacomorphic glaucoma.

Biometric studies of phacomorphic glaucoma may provide insight into the pathophysiology and show which eyes are more prone to develop glaucoma in order to initiate early treatment avoiding poor post operative visual acuity outcomes

ANTERIOR SEGMENT BIOMETRY

Anterior segment imaging has significantly altered the diagnosis and evaluation of glaucoma. The information gained with new imaging modalities provides clinicians with both qualitative and quantitative information about anatomical relationships of the anterior segment.[41]

High-frequency ultrasound biomicroscopy (UBM) is the most established anterior segment imaging device, providing objective, high-resolution images of angle structures.[50] UBM allows for visualization of structures in the posterior chamber that are otherwise hidden from clinical observation and can augment gonioscopy in the qualitative and quantitative evaluation of pathologic changes leading to angle closure.

Anterior segment optical coherence tomography (AS-OCT; Carl Zeiss Meditec, Dublin, California) and slit-lamp–adapted optical coherence tomography (SL-OCT; Heidelberg Engineering, Dossenheim, Germany) are recently developed methods that allow for objective and quantitative imaging of anterior segment structures and angle configuration.[43,44]

Advantages over UBM include noncontact methodology, with consequent reduction of patient discomfort and risk of corneal injury, and the ability to image the eye in the sitting position. However, AS-OCT and SL-OCT cannot image structures posterior to the pigment epithelium of the iris and ciliary body owing to absorption of light by this layer.

Several other imaging devices have been used to evaluate the anterior chamber. The Pentacam-Scheimpflug, a noncontact optical imaging system, has two camera components with a software program used to construct a 3-dimensional image. Important information about the cornea, anterior chamber, and lens may be obtained from these images. however, anterior chamber angle was not found to be significantly correlated with anterior chamber depth or with other quantitative angle parameters. Also, direct visualization of the angle is not possible with this device[45]

Orbscan scanning–slit topography is an alternative noncontact optical system that has primarily been used to view the cornea, although it may also have applications in angle estimation.4 Similar to Pentacam-Scheimpflug, Orbscan cannot directly visualize the angle, preventing an assessment of the structural aspects of the anterior chamber.[46]

A SCAN

A scan is a amplitude modulation scan. It gives the information in the form of one dimensional. A-scan ultrasound biometry, commonly referred to as A-scan, is

routine type of diagnostic test used in ophthalmology. The A-scan provides data on the length of the eye, which is a major determinant in common sight disorders. The most common use of the A-scan is to determine eye length for calculation of intraocular lens power.[47]

In A-scan biometry, one thin, parallel sound beam is emitted from the probe tip at its given frequency of approximately 10 MHz, with an echo bouncing back into the probe tip as the sound beam strikes each interface. An interface is the junction between any two media of different densities and velocities, which, in the eye, include the anterior corneal surface, the aqueous/anterior lens surface, the posterior lens capsule/anterior vitreous, the posterior vitreous/retinal surface, and the choroid/anterior scleral surface.[49]

The velocity of sound is determined completely by the density of the medium through which it passes. Sound travels faster through solids than through liquids, an important principle to understand because the eye is composed of both. In A-scan biometry, the sound travels through the solid cornea, the liquid aqueous, the solid lens, the liquid vitreous, the solid retina, choroid, sclera, and then orbital tissue; therefore, it continually changes velocity[46]

The known sound velocity through the cornea and the lens (average lens velocity for the cataract age group, ie, approximately 50-65 y) is 1641 meters/second (m/s), and the velocity through the aqueous and vitreous is 1532 m/s. The average

sound velocity through the phakic eye is 1550 m/s. The sound velocity through the aphakic eye is 1532 m/s, and the velocity through the pseudophakic eye is 1532 m/s plus the correction factor for the intraocular lens (IOL) material. The cornea is not routinely factored because of its thinness. If one were to consider 1641 m/s at about 0.5 mm, only 0.04 mm would need to be added to the total eye length, which in no way alters the IOL calculation[44.]

BIOMETRIC PARAMETERS OBTAINED FROM A SCAN:

- Axial length (AL)
- Anterior chamber depth (ACD)
- Lens thickness (LT)
- Vitreous distance (VD)

ULTRASOUND BIOMICROSCOPE

An imaging technique for the anterior segment study of the eye using ultrasound waves with frequencies ranging from 35 – 100 MHz This technique was developed by Pavlin, Sherar, and Foster in Toronto in the late 1980's. UBM uses high frequency ultrasound which gives near microscopic resolution of the anterior ocular segment. A quantitative and qualitative evaluation using 2D gray scale images of the various anterior segment structures are possible.[50]

Principle:

UBM uses a scan transducer having high frequency. (range of 40 – 100MHz) which provides sub surface details with high resolution. The conventional diagnostic ultrasound instrument uses 7.5 – 10 MHz frequency.

Resolution and depth of the tissue penetration of Ultrasound is decided by the transducer frequency. In ultrasonographic imaging, the lateral resolution is related to the full width of the beam at half maximum amplitude.

Image resolution comes at the expense of the reduced depth of penetration of ultrasonic beam. Approximately 5mm tissue penetration is possible with a 50MHz UBM instrument [51]

UBM – THE INSTRUMENT

1. Scanner
2. Transducers
3. LCD Screen
4. HF Probes
5. Immersion cups

THE SCANNER

A 40 – 100 MHz transducer is mover linearly. At each position, it collects 4 – 8mm radiofrequency data. The signals are received using a time gain circuit and it is amplified in proportion to the depth of the tissue

A high speed converter digitalizes a section of the detected signals corresponding to the focal zone. This is displayed as brightness on a video monitor

TRANSDUCER

High frequency transducers produce short, wide band width pulses with good sensitivity. This is made of piezoelectric polymer PVDF and co-polymers polyvinydene difluride material.[54]

CLINICAL USES OF ULTRA SOUND BIOMICROSCOPE

ANTERIOR CHAMBER ANGLE

UBM can be used to recognize iris, ciliary body and sclera spur. Sclera spur is the only constant land mark which allows the interpretation of the images and for analyzing angle pathology. The scleral spur can be identified in the region where the radio opaque shadow of the sclera merges with the relatively radio lucent shadow of the cornea.[53]

BIOMETRY OF THE ANTERIOR SEGMENT

Determination of the corneal thickness, iris thickness, ciliary body thickness, sclera thickness can be done with UBM. Measurement of the lens thickness will be difficult due to reduced penetration (< 5 mm).[55]

MECHANISM OF PRIMARY GLAUCOMA

UBM is used to determine the mechanism of elevated intra ocular pressure (angle closure versus open angle) by showing the relationship between the peripheral iris and the Trabecular mesh work.[51]

In addition, the imaging of the anterior segment structures is possible in eyes with corneal edema or corneal opacification that preludes gonioscopic assessment In open angle glaucoma, UBM can be used measure the anterior chamber angle in degrees, to assess the configuration of peripheral iris, and to evaluate iris insertion in relation to Trabecular meshwork. [56]

In eyes with a narrow angle, UBM shows the extent of the angle closure, reveals the depth of the anterior and posterior chambers, and identifies the pathological processes pushing the lens and iris forwards.

DETERMINING THE OCCLUDABILITY OF THE ANGLE

Dark room provocative testing can be performed using UBM. This will reveal the spontaneous occlusion of the angle under conditions of decreased illumination. This helps to identify ‘at risk’ population which can be subjected to a laser iridotomy.

It is better than dark room gonioscopy because the latter is time consuming and standardization of the slit lamp illumination is difficult.. Indentation UBM gonioscopy is very useful in observing the angle and diagnosis of relative pupillary block, peripheral anterior synechia and plateau iris configuration.[58]

DETERMINATION OF MECHANISM OF ANGLE CLOSURE GLAUCOMA:

In pigment dispersion syndrome, there is a classical picture on the UBM which include widely opened angle and typical posterior bowing of the peripheral iris1. In plateau iris syndrome, UBM usually reveals an abnormally steep anterior angulations of the peripheral iris, anterior insertion of the iris on the anterior ciliary body, and retroiridic projection of the ciliary process it can also confirm the double hump sign which normally seen with the gonioscopy by use of an indentation UBM, a special technique that imposes mild pressure on the peripheral cornea with the skirt of eye cup.[57]

In the eyes with peripheral anterior synechiae, UBM can reveal the extension of iridocorneal adhesions, even if the cornea is hazy or opaque. The UBM has been able to differentiate between primary angle closure and secondary angle closure due to processes such as lens swelling and dislocation, massive hemorrhagic retinal detachment pushing the lens and iris anteriorly, and multiple neuroepithelial cysts of the iridociliary sulcus.[59]

POST TRAUMATIC GLAUCOMA

After blunt ocular trauma, UBM can be used to evaluate iris angle abnormalities including angle recession, iridodialysis, cyclodialysis, and to illustrate the presence and extent of blood clots. Angle recession is characterized in UBM by a posterior displacement of the point of attachment of the iris to the sclera, a widening of the ciliary body face with no disruption of the interface between the sclera and the ciliary body. In acute stage, the post traumatic recess is usually filled with blood. In contrast, in cyclodialysis, the ciliary body is detached from its normal location at the sclera spur. [60,61]

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PSEUDOPHAKIC AND LENS INDUCED GLAUCOMA

UBM can diagnose various types of lens induced glaucomas such as phacomorphic glaucoma and glaucoma due to anterior subluxation of lens. It is helpful to know the circumference of the intact zonules and the extent of zonular dialysis in pseudo exfoliation syndrome.

In case of IOL induced glaucoma, it can clearly delineate the position of the optic and the haptic and is especially helpful in Pseudophakic bullous keratopathy cases to determine the cause for glaucoma.[59]

EVALUATION OF CYSTS AND TUMOR CAUSING ANGLE CLOSURE

Cysts and solid tumor of the anterior segment can be imaged in great detail with UBM. This technology can be used to determine the internal character of a lesion (solid or cystic), to ascertain whether the lesion invoves the anterior ciliary body or is restricted to the iris, and to measure the full extent of the lesion. UBM can reveal whether the lesion involves only partial thickness or full thickness of their stroma and can thereby aid in surgical planning.

OTHER USES

With the UBM machines one can study the blood flow in the ciliary body and see the effect of various medications / surgery on the ciliary circulation.

After Nd: YAG laser iridotomy for angle closure, UBM can show whether iridotomy is partial thickness or full thickness and whether the plane of curvature of the peripheral iris has changed compared with pretreatment findings.

After Trabeculectomy, UBM can show whether the sclerostomy aperture is patent or blocked internally, whether the peripheral iridectomy is patent and whether the filtering bleb is flat, shallow or deep.

UBM may be used in eyes which have undergone non-penetrating deep sclerectomy (NPDS) to evaluate the functional status of the surgery.

UBM of the anterior chamber angle demonstrates restoration of an open anterior chamber angle after goniosynechialysis.[60.]

After any type of glaucoma filtering surgery, UBM can be used to detect and evaluate the extend of post operative complications such as ciliochoroidal effusion and cyclodialysis. In in ciliochoroidal effusion, UBM shows the ciliary body to be edematous and separated from sclera by a sonolucent collection of supraciliary fluid

QUANTITATIVE ULTRASOUND BIOMICROSCOPY

The UBM measurement software calculates distance and area by counting the pixcel numbers along the measured line or within the measured area and multiplies the pixcel count with the size of the pixel. The UBM provides approximately 25µm of axial and 50µm of the lateral resolution.[51]

The following parameters are used for the objective analysis of the anterior chamber angle structures, with the sclera spur taken as the reference point1

TRABECULAR IRIS ANGLE (TIA)

The Trabecular iris angle (TIA) is measured with its apex at the iris recess and the arms of the angle passing through a point on the Trabecular meshwork at 500µm from the sclera spur and the point on the iris perpendicularly opposite

ANGLE OPENING DISTANCE (AOD)

The angle opening distance 250/500 (AOD250/AOD500) is the distance between the posterior corneal surface and the anterior surface measured on a line perpendicular to the trabecular meshwork, 250/500µm away from the sclera spur.

TRABECULAR-CILIARY PROCESS DISTANCE (TPCD)

The Trabecular-ciliary process distance (TPCD), is a measured on a line extending from the corneal endothelium at 500µm from the sclera spur perpendicularly through the iris, to the ciliary processes.

IRIS THICKNESS (ID)

The iris thickness (ID1) is the iris thickness measured along the same line as the TPCD. ID2 is the iris thickness at 2mm from the iris root and ID3 is maximum iris thickness near pupillary margin

IRIS-CILIARY PROCESS DISTANCE (ICPD)

The iris-ciliary process distance (ICPD), is the distance measured from the posterior iris surface (iris pigmented epithelium) to the ciliary process along the same line as the TCPD

IRIS LENS CONTACT DISTANCE (ILCD)

The iris lens contact distance (ILCD), is measured along the iris pigmented epithelium from the pupillary border to the point where anterior lens surface leaves the iris.

CLINICAL APPLICATION OF QUANTITATIVE ULTRASOUND MICROSCOPY

QUANTIFICATION OF THE ANTERIOR CHAMBER ANGLE

With the UBM, one can draw calipers and directly measure the angle recess precisely. This is a very objective method which is not possible with gonioscopy. It helps to determine the exact degree of angle closure and assess whether a patient is predisposed to angle closure.

An automated analysis of parameters can be performed with UBM Pro software. Ishikawa H et al 20 described as a quantitative method for the measuring the irido-corneal recess area and , using this , to evaluate factors associated with

appositional angle closure during dark room provocative testing using UBM. They calculated a ARA linear regression formula which provides useful quantitative information about angle recess anatomy. They concluded that the more posterior the iris insertion on the ciliary face, the less likely the provocative test will be positive.

RELATED STUDIES

Sihota et al has studied anterior segment parameters in the subtypes of primary angle closure glaucoma (PACG) using ultrasound biomicroscopy. They concluded that eyes with primary angle closure glaucoma have a thinner iris with a shorter trabecular iris angle, angle opening distance, and trabecular ciliary process distance. The eyes with acute primary angle closure glaucoma have the narrowest angle recess[59]

Marchini et al has studied the biometric findings of ocular structures in primary angle-closure glaucoma (PACG). It was an observational case series with comparisons among three groups (patients with acute/intermittent PACG, patients with chronic PACG, and normal subjects).They concluded that in patients with PACG, the anterior segment is more crowded because of the presence of a thicker, more anteriorly located lens. The UBM confirms this crowding of the anterior segment, showing the forward rotation of the ciliary processes. A gradual

progressive shift in anatomic characteristics is discernible on passing from normal to chronic PACG and then to acute/intermittent PACG eyes[56]

Materials and methods

MATERIALS AND METHODS

A cross-sectional study was conducted during a period March 2008 to November 2009 at Institute Of Ophthalmology, Joseph Eye Hospital, Trichy.

A total of 75 eyes were, 15 phacomorphic glaucomatous eyes and the consecutive normal other eyes (total – 30), 15 intumescent cataractous eyes and the consecutive normal other eyes (total – 30) and 15 normal eyes in each group were studied. Study was in accordance with the regulations laid down in the Declaration of Helsinki. It was approved by the Institutional Review Board of our Institute. Informed consent was obtained from all patients in the study by providing details of the study.

NORMAL GROUP

INCLUSION CRITERIA

- Visual acuity of 6/60 or more on Snellens or E chart
- Normal anterior chamber depth on Slit lamp Biomicroscopy
- Open anterior chamber angles on Volk four mirror gonioscopy
- Intraocular pressure of 21mm of Hg or less
- Normal or cataractous lens without intumescence.

INTUMESCENT CATARACT GROUP

INCLUSION CRITERIA

- Intumescent cataract on slit lamp Biomicroscopy
- Shallow anterior chamber on clinical examination
- Open or closed anterior chamber angles on Volk four mirror gonioscopy
- Intraocular pressure (IOP) of 21mm of Hg or less

PHACOMORPHIC GLAUCOMA GROUP

INCLUSION CRITERIA

Clinical diagnostic criteria:

- High intraocular pressure (IOP) > 35 mm Hg on Goldmann Applanation tonometry
- Mid dilated, sluggish, irregular pupil
- Corneal edema
- Injection of conjunctival and episcleral vessels
- Shallow central anterior chamber (AC) on slit lamp Biomicroscopy
- Closed anterior chamber angles on Volk four mirror gonioscopy

EXCLUSION CRITERIA – for all three groups

- Patients physically unfit to undergo UBM.
- Anterior segment findings like corneal opacity, healed ulcer etc...
- Patients with ocular trauma, ocular surgery, laser therapy
- Pre-existing glaucoma.
- Clinical exclusion of other causes of shallow anterior chamber

VISUAL ACUITY

Visual acuity was recorded using Snellens visual acuity chart and illiterate 'E' chart for all the patients. Patients with perception of light (PL) were also checked for projection of rays (PR) also.

SLIT LAMP EXAMINATION was done for all the cases.

INTRA OCULAR PRESSURE

Intra ocular pressure was measured using Goldmann Applanation tonometer for all the patients before UBM (once the corneal edema subsides after medical therapy in case of phacomorphic eyes).

INDIRECT OPHTHALMOSCOPY AND B SCAN

Direct ophthalmoscopy using 90 D Lens was performed in all study eyes and in cases of dense cataracts, B scan ultrasound was done to evaluate the posterior segment status.

CENTRAL CORNEAL THICKNESS

Central corneal thickness was measured for the all the patients using specular microscope

All the clinical assessment tests were done by a single qualified ophthalmologist and same slit lamp, Applanation tonometer, gonioscope and B scan was used for evaluating the eyes.

Before performing A scan and UBM, measures to decrease intraocular pressure included topical application of Timolol maleate 0.5% twice daily supplemented with oral Acetazolamide 250 mg four times a day, and oral glycerol 50% 1 oz twice a day

INSTRUMENTATION AND PROCEDURE

A SCAN

A scan biometry was performed after obtaining consent from the patient. In the supine position, 2% Lignocaine one drop is instilled in both eyes and the A scan imaging was performed by contact method in both eyes using **OcuScan® (Alcon**

laboratories, Inc. Texas, USA). All the parameters were recorded in the study proforma and UBM imaging was also done in the same sitting for all the study eyes.

The parameters studied were

- Axial length(AL)
- Anterior chamber depth(ACD)
- IOL power
- Lens thickness(LT)
- Vitreous distance (VD)
- Relative lens position (ACD + LT/2 / AL)

ULTRASOUND BIOMICROSCOPE

Images of the anterior chamber angles were obtained using the UBM (model Marvel B scan with UBM®, Appasamy medical equipment (P) LTD) with a 35-MHz transducer probe. Patients were imaged in the supine position.

After administering 2% Lignocaine, one drop topical anesthesia, a plastic eyecup was used to gently part the eyelids and retain a layer of 2% methylcellulose coupling agent, with care not to exert pressure on the globe.

Three standard axial image sections were obtained at the 3-, 6-, and 9-o'clock positions under standard lighting conditions (26.14 candela/m2). Variation in

accommodation was minimized by fixation with the contralateral eye on a standard distance target on the ceiling.

The output of the UBM was stored on computer for analysis using UBM inbuilt software. A single observer performed all analyses 2 times. If the angle-opening distance (AOD) at 500 µm from the scleral spur differed by more than 10%, then a third analysis was performed on that image and the median value was used.

To analyze the image using the UBM Pro2000 software, the operator identified the scleral spur. The software then automatically calculated the distance along a perpendicular line drawn from the corneal endothelial surface to the iris at 500 µm.

PARAMETERS OBTAINED FROM UBM IMAGING

- Trabecular iris angle (TIA)
- Angle opening distance (AOD)
- Trabecular-ciliary process distance (TPCD)
- Iris thickness (ID)
- Iris-ciliary process distance (ICPD)
- Iris lens contact distance (ILCD)
- Iris zonular distance (IZD)
- Anterior chamber depth (ACD)

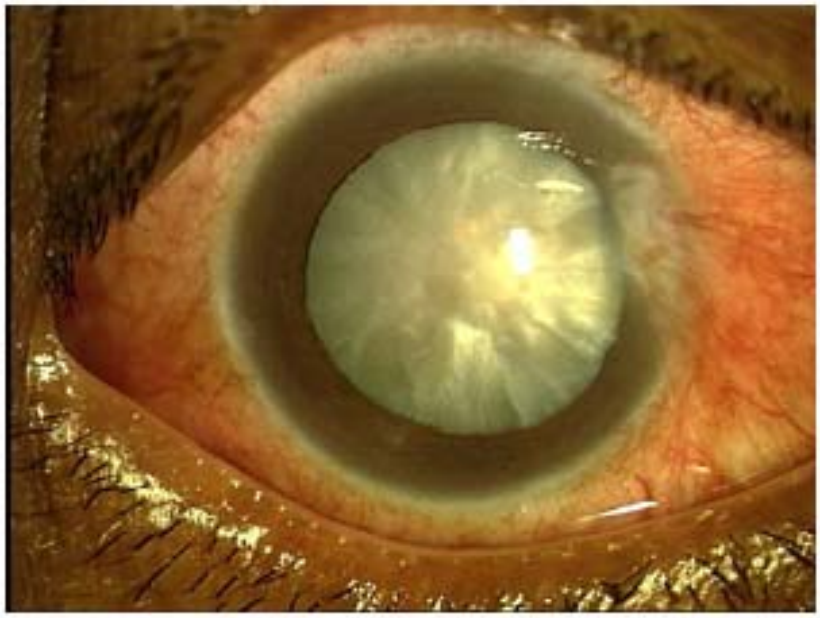
- Lens thickness (LT2)

STATISTICAL ANALYSIS : Statistical analysis of the data was done using SPSS version (13.0).

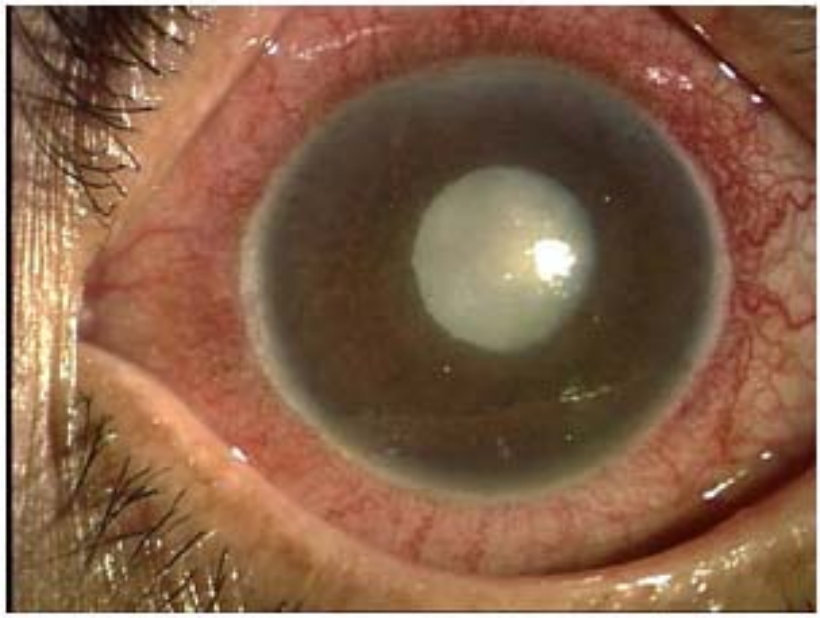
A SCAN

ULTRASOUND BIOMICROSCOPE

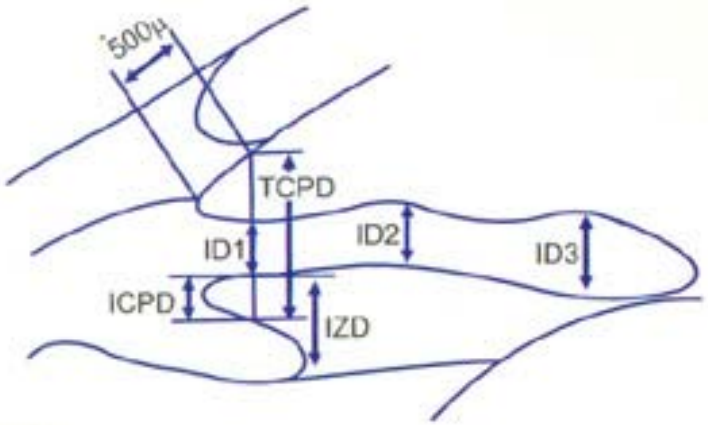
INTUMESCENT CATARACT



PHACOMORPHIC GLAUCOMA



UBM PARAMETERS



UBM PROCEDURE

Results

RESULTS

A total of 47 patients (77 eyes) were included in the study out of which 19 were males and 28 were females with age ranging from 35 years to 82 years.

In the normal group, a total of 17 eyes were studied of which 11 were females and 6 were males. The age of the patients ranged from (40 to 74) years with a mean age of 58.29 ±7.83. In the intumescent cataract group, a total of 15 eyes (n=15) were studied out of which 9 were female and 8 were males. The mean age was 62.87±9.56yrs. In the phacomorphic glaucoma group, a total of 15 eyes (n=15), 8 were females and 7 were males. The mean age was 59.27±8.77yrs (TABLE-1)

In normal group, mean intra ocular pressure (IOP) was 16±2.55mmHg. In intumescent group, mean IOP was 16.27±3.45mmHg and in phacomorphic eyes, it was 45.33±14.34mmHg.

ASCAN PARAMETERS

In normal group, axial length (AL) ranged from 21.23mm to 23.57mm with a mean axial length of 22.45±0.72mm. In intumescent group, the mean axial length was 22.35±0.86mm. In phacomorphic group, the mean axial length was

22.24±1.17mm. The axial length of the phacomorphic and the intumescent eyes were less than in the normal eyes but the difference was not statistically significant. (*P= 0.634* and *0.673* respectively) (TABLE-2)

Axial length of the fellow eye of the intumescent cataract had a mean axial length of 22.15±0.88mm and the fellow eye of phacomorphic glaucoma eye had a mean axial length of 21.52±1.59mm. The axial length of the fellow eye was less than the phacomorphic eye. (*P=0.024*)

In normal eyes, mean anterior chamber depth (ACD) was 2.75±0.25mm. In the intumescent group, mean ACD was 2.32±0.51mm. Phacomorphic glaucoma eyes had a mean ACD of 2.54±0.58mm. Only in intumescent group, the anterior chamber depth measured by A scan (ACD) was less when compared to ACD of normal eyes (2.75±0.25mm) (*p= 0.006*).

In normal eyes, mean of vitreous distance (VD) was 15.41±0.74mm. In the intumescent eyes, mean VD was 16.6±0.80mm and in phacomorphic eyes, mean VD was 15.92±1.66mm. Mean VD for normal eyes was (15.41±0.74mm) when compared with intumescent eyes (16.6±0.80mm), the difference was statistically significant (*p=0.001*) but it was not so with the phacomorphic group. (GRAPH – 2)

Central corneal thickness (CCT) measured in normal eyes had mean value of 506.41±23.98µ. . Mean CCT in intumescent cataract group was 509.5±331.2µ and in the phacomorphic eyes was 525±45.65µ.

UBM PARAMETERS

Trabecular iris angle (TIA) in the normal group ranged from 30.9 ° to 48.2° with a mean TIA of 38.4°±4.90°. In the Intumescent cataract group mean TIA was 23.7° ±4.67°. In the phacomorphic glaucoma group, the mean TIA was 17.35°±3.2°. TIA of the phacomorphic group (17.35±3.27°) and the intumescent group (23.7±4.67°) were significantly less than in the normal group (38.4±4.9°) (*p= 0.001*) (GRAPH – 3)

Mean Angle opening distance (AOD) in the normal group was 0.40±0.06mm. In the intumescent eyes, mean AOD was 0.23±0.61mm and in phacomorphic eyes, mean AOD was 0.19±0.23mm. AOD was significantly reduced in the phacomorphic group (0.19±0.22mm) and the intumescent group (0.23±0.06mm) when compared to normal group (0.40±0.06mm). (*P =0.009* and *0.000* respectively).

Iris thickness (ID) was measured in three positions; ID1, ID2, ID3. In normal eyes, mean ID1 was 0.36±0.08mm, mean ID2 was 0.50±0.12mm and ID3 mean value was 0.63±0.87mm. In intumescent group, the mean ID1, ID2 and ID3 values were 0.25±0.11mm, 0.38±0.11mm, 0.58±0.14mm respectively and in

phacomorphic glaucoma group, mean ID1 was 0.32±0.13mm, mean ID2 was 0.39±0.10mm and ID3 mean value was 0.5±0.13mm.

Mid iris thickness and iris thickness close to pupillary margin were found to be decreased in phacomorphic group (ID2-0.39±0.10mm), (ID3-0.50±0.13) when compared to normal group (ID2-0.50±0.11mm), (ID3–0.60±0.08mm) (*p= 0.001* for both ID2 and ID3).

In intumescent group, ID1 was 0.25±0.11mm and ID2 was 0.38±0.11mm.These were found to be significantly decreased in intumescent group when compared to normal eyes (*p=0.007* and *p=0.015* respectively). (GRAPH–1)

In normal eyes, mean iris lens contact distance (ILCD) was 0.63±0.19. Mean ILCD in intumescent eyes was 0.86±0.19mm and 1.03±0.27mm in phacomorphic eyes. The ILCD was more in the phacomorphic group (1.02±0.26mm) than in the normal group (0.63±0.19mm) (*p=0.000*) and similarly more also in the intumescent eyes (0.86±0.32mm) were compared with normal eyes, *(p=0.160)*

Mean anterior chamber depth measured using UBM (ACD) in normal eyes was 2.68±0.27mm. In intumescent eyes, it was 1.62±0.48mm and phacomorphic group mean ACD was 1.75±0.83mm. ACD in phacomorphic eyes (1.74±0.82mm)

and intumescent group (1.62±0.47mm) were less the difference was statistically significant. (*p=.003* and *p=0.000* respectively).

Mean Iris zonular distance (IZD) in the normal group was 0.56±0.16mm, intumescent group showed a mean IZD of 0.40±0.18mm and phacomorphic eyes had a mean IZD of 0.54±0.19mm. Mean IZD was found to be decreased in intumescent group (0.4±0.18mm) when compared to the normal group (0.56±0/16mm) (*p= 0.004*). The difference was not statistically significant when phacomorphic and normal eyes were compared. (TABLE – 2)

GROUPS	Normal	Phacomorphic	Intumescent	Statistical analysis	Statistical analysis
	A	B	C	A Vs B	A Vs C
AL (mm)	22.45 ± 0.72	22.24 ± 1.17	22.35 ± 0.86	0.634	0.673
VD (mm)	15.41 ± 0.74	15.92 ± 1.66	16.61 ± 0.8	0.173	0.001
TIA (degree)	38.4 ± 4.9	17.35 ± 3.27	23.7 ± 4.67	0.000	0.000
AOD (mm)	0.4 ± 0.06	0.19 ± 0.22	0.23 ± 0.06	0.009	0.000
ID1 (mm)	0.36 ± 0.08	0.32 ± 0.12	0.25 ± 0.11	0.192	0.007
ID2 (mm)	0.5 ± 0.11	0.39 ± 0.1	0.38 ± 0.11	0.001	0.015
ID3 (mm)	0.6 ± 0.08	0.5 ± 0.13	0.58 ± 0.14	0.001	0.382
ILCD (mm)	0.63 ± 0.19	1.02 ± 0.26	0.86 ± 0.32	0.000	0.160
ACD (mm)	2.68 ± 0.27	1.74 ± 0.82	1.62 ± 0.47	0.003	0.000
IZD (mm)	0.56 ± 0.16	0.54 ± 0.19	0.4 ± 0.18	0.378	0.004

TABLE – 2

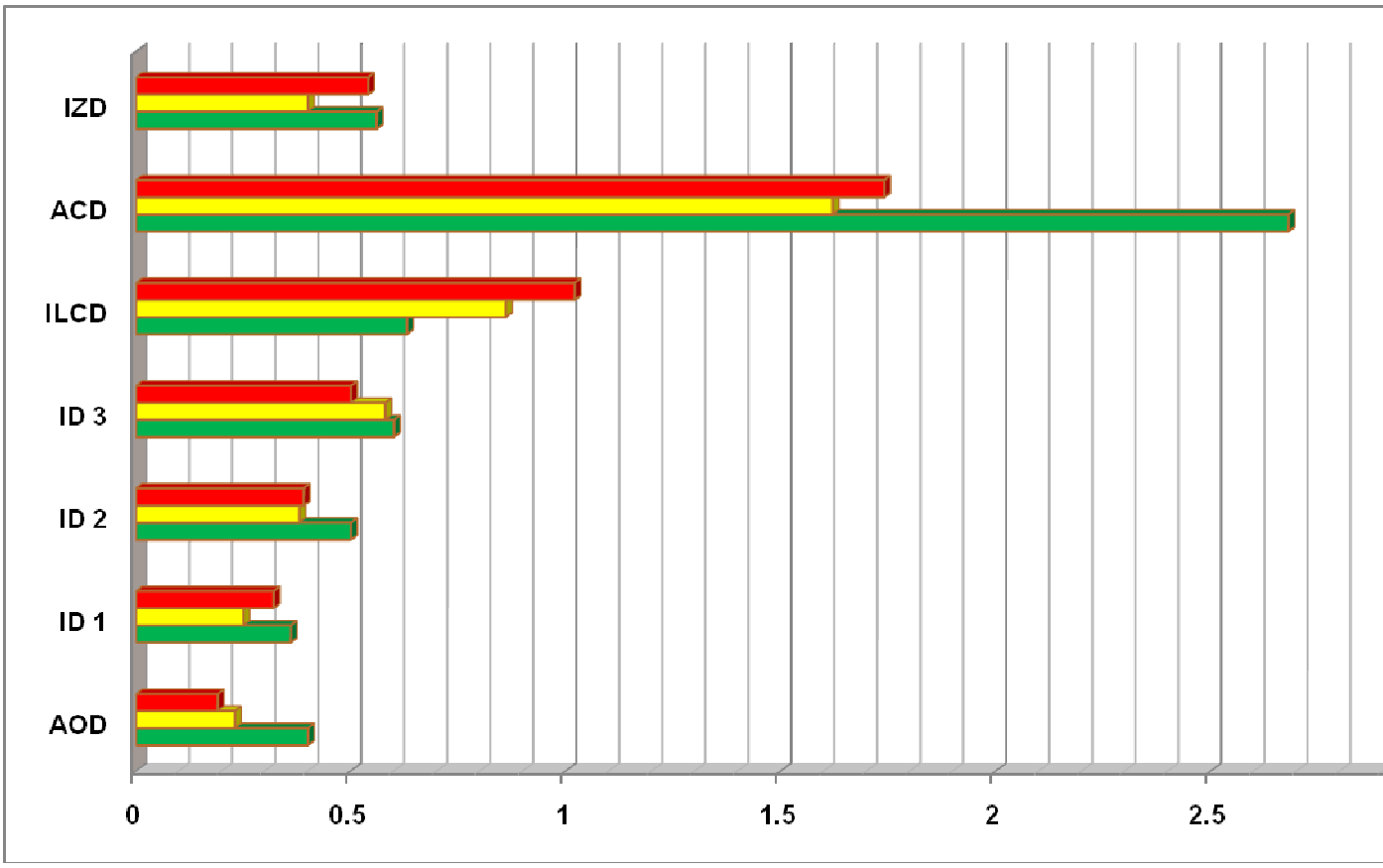
ANTERIOR SEGMENT BIOMETRY OF NORMAL, PHACOMORPHIC AND INTUMESCENT EYES

Demographic Table

Groups	Normal n= 17	Phacomorphic n= 15	Intumescent n= 15
Age (years)	58.29 ± 7.83	59.27 ± 8.77	62.87 ± 9.5
Male : Females (eyes)	6 : 11	7 : 8	6 : 9
Mean IOP (mmHg)	16 ± 2.55	45.33 ± 14.34	16.27 ± 3.45

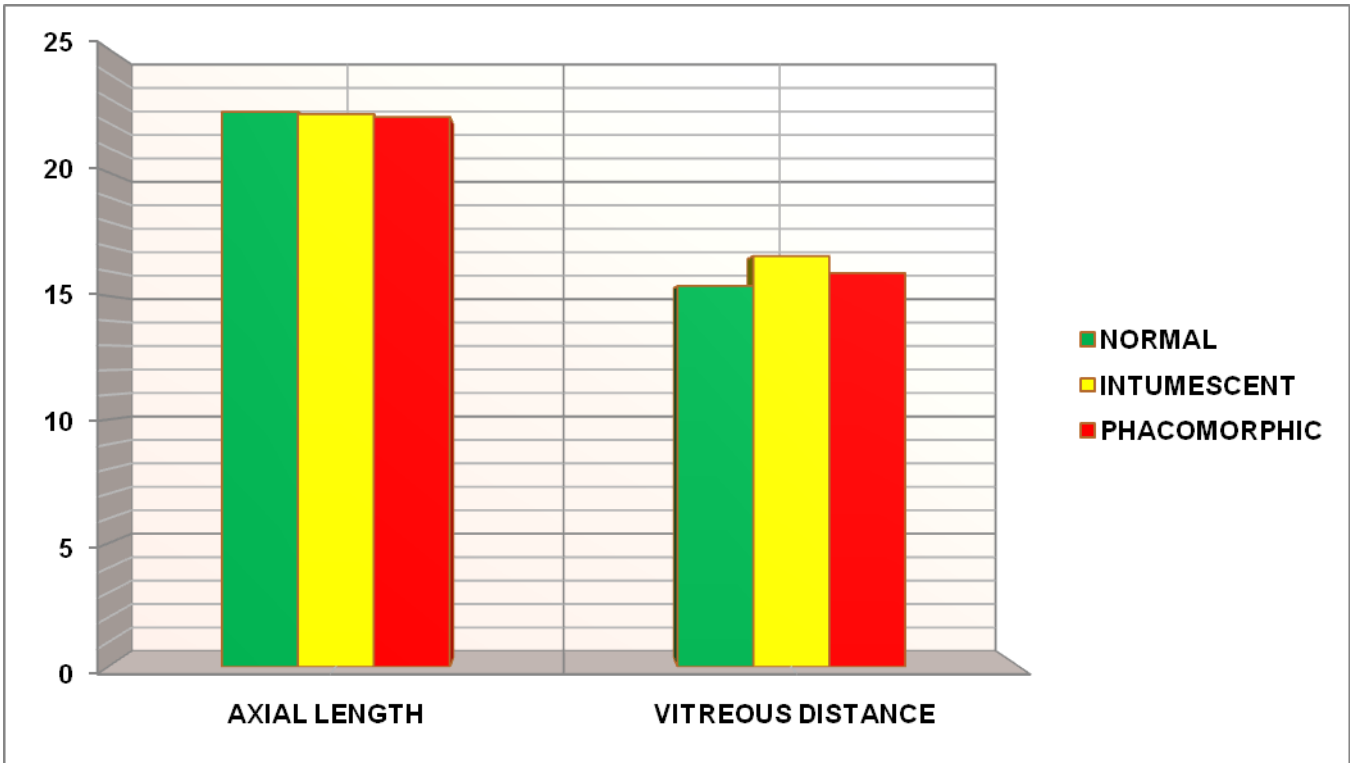
TABLE - 1

ANTERIOR SEGMENT BIOMETRY IN NORMAL, INTUMESCENT AND PHACOMORPHIC EYES



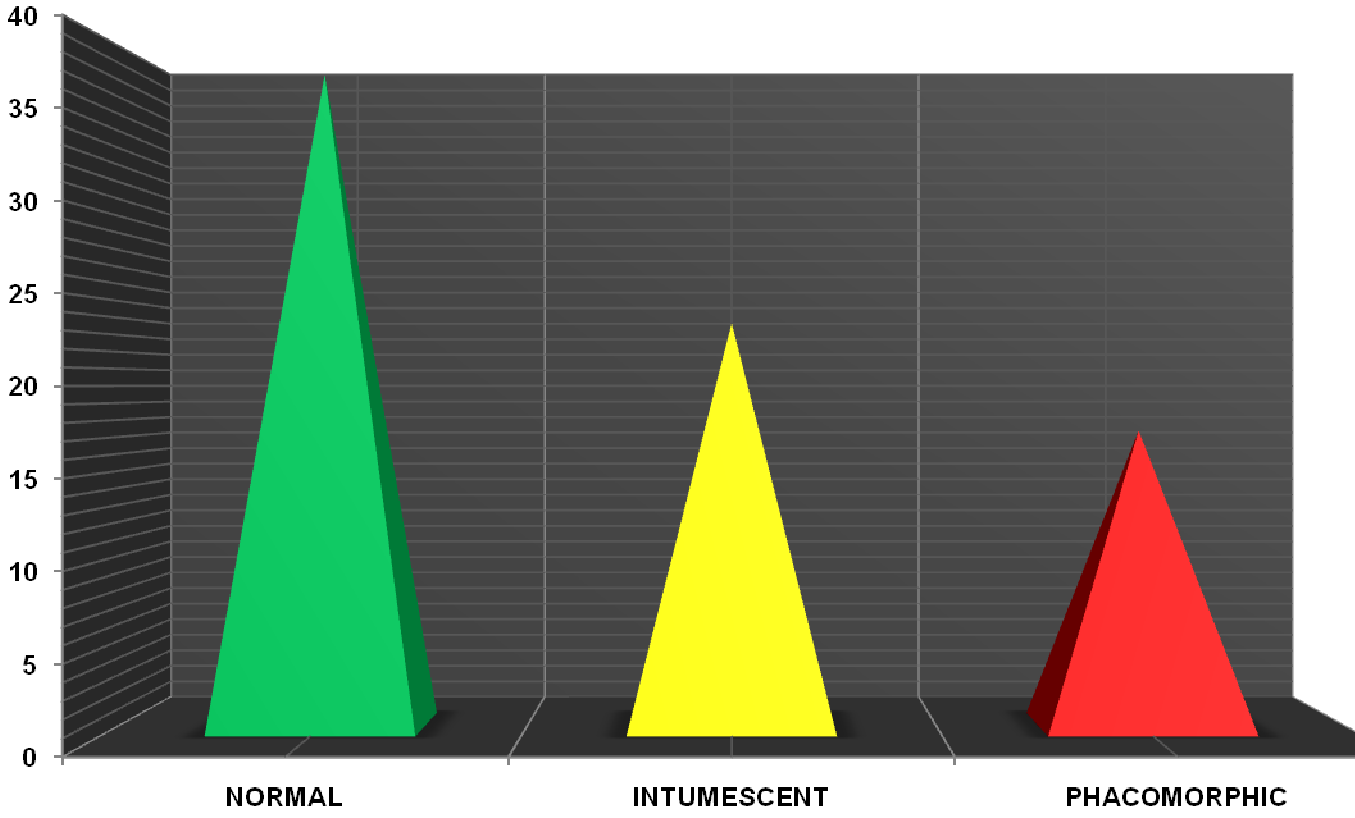
GRAPH - 1

AXIAL LENGTH AND VITREOUS DISTANCE IN 3 GROUPS



GRAPH - 2

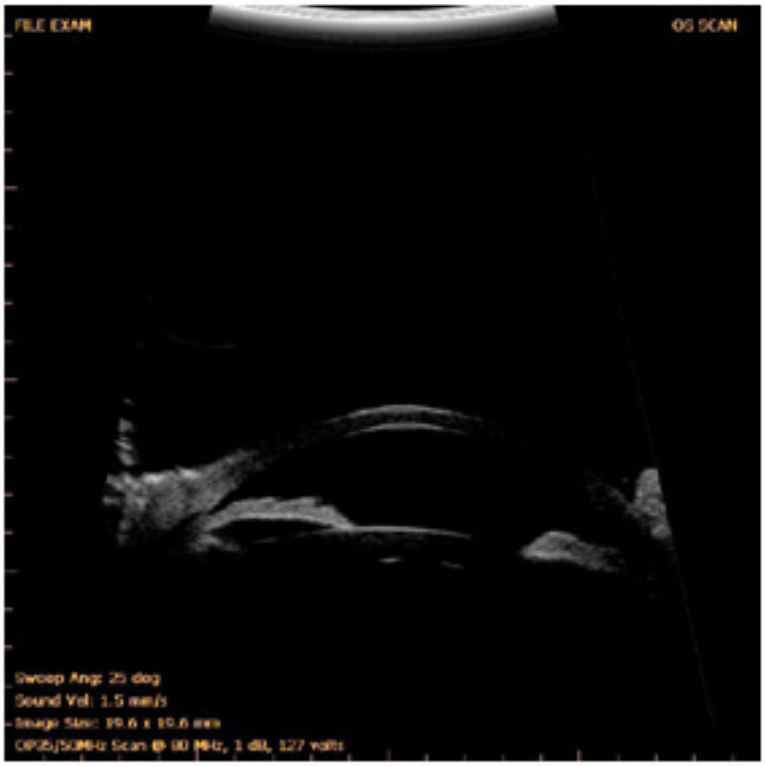
TRABECULAR IRIS ANGLE IN 3 GROUPS



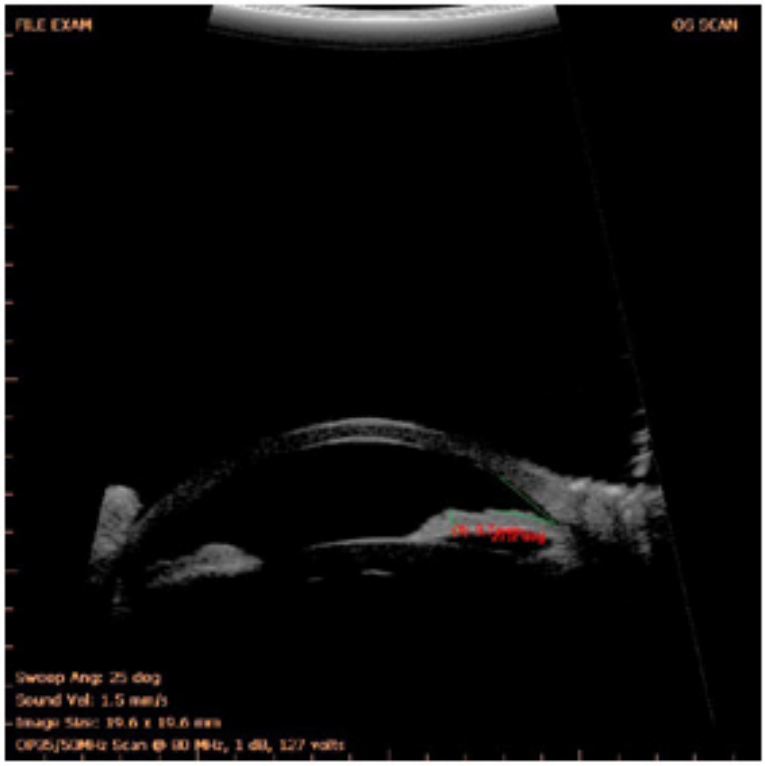
GRAPH - 3

UBM IMAGE OF NORMAL EYE

UBM IMAGE OF NORMAL EYE

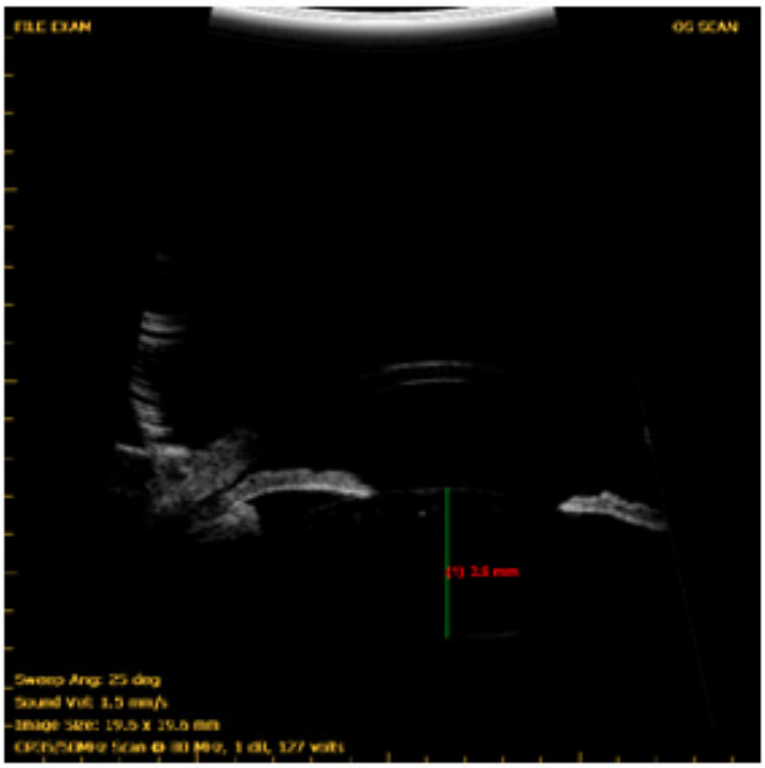


UBM IMAGE OF INTUMESCENT CATARACT



UBM MEASUREMENT OF AC DEPTH

UBM MEASUREMENT OF LENS THICKNESS



Discussion

DISCUSSION

Biometric studies of phacomorphic glaucoma may provide insight into the pathophysiology and show which eyes are more prone to develop glaucoma in order to initiate early treatment.

Anterior segment imaging may prove in future to be an additional diagnostic tool and aid in the diagnosis and evaluation of glaucoma. The information gained may provide the clinician with both qualitative and quantitative information about anatomical relationships of the anterior segment.

The mean age of patients with phacomorphic glaucoma was 59.27±8.77yrs and that of intumescent cataract patients was 62.87±9.56yrs. Prajna et al in their study done on Indian eyes with lens induced glaucoma found that the mean age at presentation was 62±10 years (range 43-85) for phacomorphic glaucomas. Older patients present with phacomorphic glaucoma.[65]

In our study, the male to female ratio for phacomorphic glaucoma was 7:8 males (46.6%) and females(53.3%) and for intumescent cataract patents was 6:9 males (40%) and females (60%). Prajna et al in their study also found a slight female preponderance (54%) compared to the males (46%) for phacomorphic glaucoma.[65]

In our study, mean axial length of the phacomorphic glaucoma eyes was 22.24±1.17mm and that in the intumescent cataract eyes was 22.35±0.86mm. These were less than axial length of normal eyes (22.45±0.72mm) but this was not statistically significant. Axial length of fellow eye of phacomorphic glaucoma eyes was 21.52±1.59mm, which was less when compared to the phacomorphic eye (22.24±1.17mm)) (*p=0.024*).

Marchini et al in their study found that compared to normal subjects, the patients with PACG presented a shorter axial length (Acute PACG = 22.31±0.83 mm, chronic PACG = 22.2± 0.94 mm, normal eyes = 23.38±1.23 mm).[66]

In our study, AC depth measured using UBM (ACD), both phacomorphic (1.74±0.82) and intumescent eyes (1.62±0.47mm) had reduced AC depth than the normal eyes (3.95±0.27mm).(P=*0.003* and *0.000* respectively)

Lin-YW et al state that the AC depth < 2.7mm was more sensitive and specific parameter to differentiate acute PACG from normal patients. Mean axial length in their study in PACG patients was 22.25±0.77mm, ACD was 2.28±0.23mm.[67]

Increased distance between the posterior surface of the lens to the anterior surface of the retina (Vitreous distance VD) was found in the eyes with intumescent cataract than the normal eyes.

In our study, mean trabecular iris angle (TIA) was 17.35±3.27° in phacomorphic glaucoma and 23.7±4.67°in intumescent cataract patients .This was significantly less than in normal eyes. This can be compared to the study done by Marchini et al in Caucasian eyes with primary angle closure glaucoma where the TIA averaged 11.7±8.8°and 19.9±9.8° and 31.3±9.2°in patients with acute, intermittent and chronic ACG respectively.

Sihota etal found that eyes with primary angle closure glaucoma have a shorter trabecular iris angle (TIA). In their study, the trabecular iris angle of control and POAG groups was more than all the subtypes of PACG ($P < 0.001$).[68]

Angle opening distance (AOD) which quantifies the iridotrabecular apposition has been proposed to predispose to peripheral anterior synechiae.In this study it was found to be decreased in patients with intumescent cataract (0.23±0.06mm) and in eyes with phacomorphic glaucoma (0.19±0.22mm) than in normal eyes (0.40±0.06mm) which can be comparable to the findings of Pavlin and foster et al.[69]

In their study the mean AOD in PACG was 0.11±34mm. Woo et al examined 24 eyes with clinically narrow angles and pupillary block configuration at UBM and found that the mean AOD was decreased significantly which was 0.18±29mm and 0.1±18mm in light and dark conditions respectively.[71]

Yaniv et al in their study state that the mean AOD was decreased significantly in the eyes with appositional angle closure when compared to eyes with open angles.[70]

In our study, iris thickness measured close to iris root (ID1) was found to be reduced in patients with phacomorphic glaucoma (0.32±0.13mm) and iris thickness (ID2) measured 2mm from the scleral spur which was found reduced in both phacomorphic glaucoma (0.39±0.10mm) and intumescent cataract (0.38±0.11mm). Iris thickness measured close to the pupillary margin (ID3) was found to be reduced in patients with intumescent cataract (0.58±0.14mm).

Sihota et al studied iris thickness in five groups, each comprising 30 consecutive patients, diagnosed to have subacute PACG, acute PACG, chronic PACG, primary open angle glaucoma (POAG), and healthy controls found that, eyes with acute PACG had the least iris thickness at the three different positions.[68]

The contact surface between the iris and the lens was quantified by iris lens contact distance (ILCD) which was found to be more in phacomorphic glaucoma

patients (1.02±0.26mm) in our study. Nemeth et al in their study, Ultrasound Biomicroscopic morphometry of the anterior eye segment before and after one drop of pilocarpine, found that, contact surface between the lens and iris increased significantly after one drop of pilocarpine.

Iris-zonule distance (IZD) which shows the position of the iris insertion was found to be decreased in eyes with intumescent cataract (0.4±0.18mm) than normal eyes (0.40±0.18mm). Yao BQ et al studied IZD before and after laser peripheral iridectomy in the fellow eyes of acute primary angle closure and had found similar results as in our study.

Summary

SUMMARY

Aim of the study was to analyze anatomical parameters and biometric findings of ocular structures in phacomorphic glaucoma, intumescent cataract and compare them with normal eyes using Ultrasound Biomicroscope and conventional A Scan

A cross-sectional study was conducted during a period March 2008 to November 2009 at Institute Of Ophthalmology, Joseph Eye Hospital, Trichy. A total of 75 eyes were, 15 phacomorphic glaucomatous eyes and the consecutive normal other eyes (total – 30), 15 intumescent cataractous eyes and the consecutive normal other eyes (total – 30) and 15 normal eyes in each group were studied.

A SCAN AND UBM imaging was done for all the eyes after a comprehensive ophthalmological evaluation. The parameters studied were axial length, anterior chamber depth, IOL power, lens thickness, vitreous distance, relative lens position and UBM parameters were trabecular iris angle ,angle opening distance trabecular-ciliary process distance, iris thickness, iris-ciliary process distance, iris lens contact distance, iris zonular distance, anterior chamber depth, lens thickness

Statistical analysis of the data was done using SPSS version (13.0).

The mean age of patients with phacomorphic glaucoma was 59.27±8.77yrs and that of intumescent cataract patients was 62.87±9.56yrs. , the male to female ratio for phacomorphic glaucoma was 7:8 males (46.6%) and females(53.3%) and for intumescent cataract patents was 6:9 males (40%) and females (60%)

AC depth measured using UBM (ACD), both phacomorphic (1.74±0.82) and intumescent eyes (1.62±0.47mm) had reduced AC depth than the normal eyes (3.95±0.27mm).(P=*0.003* and *0.000* respectively)

Increased distance between the posterior surface of the lens to the anterior surface of the retina (Vitreous distance VD) was found in the eyes with intumescent cataract than the normal eyes

Mean trabecular iris angle (TIA) was 17.35±3.27° in phacomorphic glaucoma and 23.7±4.67°in intumescent cataract patients. This was significantly less than in normal eyes.

Angle opening distance (AOD) which quantifies the iridotrabecular apposition has been proposed to predispose to peripheral anterior synechiae. In this study it was found to be decreased in patients with intumescent cataract (0.23±0.06mm) and in eyes with phacomorphic glaucoma (0.19±0.22mm) than in normal eyes (0.40±0.06mm)

In our study, iris thickness measured close to iris root (ID1) was found to be reduced in patients with phacomorphic glaucoma (0.32±0.13mm) and iris thickness (ID2) measured 2mm from the scleral spur which was found reduced in both phacomorphic glaucoma (0.39±0.10mm) and intumescent cataract (0.38±0.11mm). Iris thickness measured close to the pupillary margin (ID3) was found to be reduced in patients with intumescent cataract (0.58±0.14mm).

The contact surface between the iris and the lens was quantified by iris lens contact distance (ILCD) which was found to be more in phacomorphic glaucoma patients (1.02±0.26mm) in our study.

Iris-zonule distance (IZD) which shows the position of the iris insertion was found to be decreased in eyes with intumescent cataract (0.4±0.18mm) than normal eyes (0.40±0.18mm).

Biometric studies of phacomorphic glaucoma may provide insight into the pathophysiology and show which eyes are more prone to develop glaucoma in order to initiate early treatment.

Anterior segment imaging may prove in future to be an additional diagnostic tool and aid in the diagnosis and evaluation of glaucoma. The information gained may provide the clinician with both qualitative and quantitative information about anatomical relationships of the anterior segment.

Conclusion

CONCLUSION

Eyes with phacomorphic glaucoma and intumescent cataract have a shorter anterior chamber depth, thinner iris with a shorter trabecular iris angle, angle opening distance, and iris lens contact distance. Apart from these parameters, the intumescent eyes had a longer vitreous distance and iris-zonule distance.

The UBM confirms this crowding of the anterior segment. A gradual progressive shift in anatomic characteristics is discernible on passing from intumescent cataract to phacomorphic glaucoma. The contact surface between the iris and the lens as quantified by iris lens contact distance (ILCD) signifies that pupillary block mechanism could also be one of the causes for glaucoma in phacomorphic eyes.

Increased distance between the posterior surface of the lens to the anterior surface of the retina (Vitreous distance VD) may be due to forward shift of anterior segment structures and may be one of the probable reasons for the pathogenesis of the disease.

Significant reduction in the anterior chamber angle parameters like trabecular iris angle and angle opening distance measured by UBM augments the gonioscopic observations and UBM provides high resolution images of the angle structures in the posterior chamber otherwise hidden from clinical observation and

helps in the qualitative and quantitative evaluation of pathological changes leading to phacomorphic glaucoma.

UBM may help the clinician in evaluation and diagnosis in patients with phacomorphic glaucoma by providing additional information regarding anterior segment structures and their relationship to related structures.

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Proforma

Case No:
Normal/ Intumescent/Phacomorphic

Name: Sex: M / F Age: MR No:

FINDING	RE	LE
Visual acuity		
IOP		
Cornea		
AC Depth		
Pupil		
Lens		
Gonioscopy		
B Scan		

A Scan

Axial Scan		
K reading		
IOL Power		
ACD		
LT		
VD		
Other findings		
CCT		

UBM

TIA		
AOD		
TCPD		
ID		
ICPD		
ILCD		
IZD		
ACD		
LT		

TIA –Trabecular iris angle, AOD- Angle opening distance, TCPD-Trabecular ciliary process distance, ID-Iris thickness, ICPD-Iris ciliary process distance, ILCD- Iris lens contact distance, ACD-AC depth, LT-Lens thickness, VD-Vitreous distance, CCT- Central corneal thickness